1. A functionalized, encapsulated fluorescent nanocrystal comprising

(a) a liposome;

(b) one or more fluorescent nanocrystals encapsulated by the liposome; and

(c) surface groups, wherein an outer surface of the liposome comprises the surface groups, and wherein the surface groups are selected from the group consisting of one or more reactive functionalities, one or more affinity molecules, and a combination thereof.

2. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein a fluorescent nanocrystal of the one or more fluorescent nanocrystals encapsulated by the liposome comprises a semiconductor nanocrystal.

3. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein a fluorescent nanocrystal of the one or more fluorescent nanocrystals encapsulated by the liposome comprises a doped metal oxide nanocrystal.

4. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein a plurality of fluorescent nanocrystals are encapsulated by the liposome, and the plurality of fluorescent nanocrystals comprise a combination of one or more doped metal oxide nanocrystals, and one or more semiconductor nanocrystals.

5. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the liposome further comprises a component for substitution selected from the group consisting of a membrane stabilizer, an isotonic agent, a pH

adjusting agent, an aggregation minimizer, an affinity molecule, an amino acid, and a combination thereof.

6. The functionalized, encapsulated fluorescent nanocrystal according to claim 5, wherein the liposome comprises a membrane stabilizer selected from the group consisting of one or more sterols, one or more fatty acids, one or more amino acids, and a combination thereof.

7. The functionalized, encapsulated fluorescent nanocrystal according to claim 6, wherein the liposome comprises one or more phospholipids and one or more sterols.

8. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise a reactive functionality comprising free amino groups.

9. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise a reactive functionality comprising thiol-reactive groups.

10. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise a reactive functionality comprising free thiol groups.

11. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise a reactive functionality comprising free carboxyl groups.

12. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise an affinity molecule comprising a monoclonal antibody.

13. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise a reactive functionality coupled to an affinity molecule comprising a monoclonal antibody.

14. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise an affinity molecule comprising a nucleobase.

15. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise a reactive functionality coupled to an affinity molecule comprising a nucleobase.

16. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise an affinity molecule comprising a nucleic acid molecule.

17. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the surface groups comprise a reactive functionality coupled to an affinity molecule comprising a nucleic acid molecule.

18. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the liposome is comprised of one or more cationic lipids and one or more helper lipids in forming a liposome adapted for transfection.

19. The functionalized, encapsulated fluorescent nanocrystal according to claim 1, wherein the liposome is comprised of one or more cationic lipids in forming a liposome adapted for transfection.

20. The functionalized, encapsulated fluorescent nanocrystal according to claim 18, further comprising a nucleic acid molecule.

21. The functionalized, encapsulated fluorescent nanocrystal according to claim 18, further comprising a nucleic acid molecule.

22. A complex comprised of a plurality of functionalized encapsulated fluorescent nanocrystals according to claim 18, and nucleic acid molecule.

23. A complex comprised of a plurality of functionalized encapsulated fluorescent nanocrystals according to claim 19, and nucleic acid molecule.

24. A method of using functionalized, encapsulated fluorescent nanocrystals according to claim 1 in a detection system, wherein the surface groups comprise an affinity molecule, the method comprising the steps of:

(a) contacting the functionalized, encapsulated fluorescent nanocrystals with a sample being analyzed for the presence or absence of a substrate for which the affinity molecule has binding specificity, wherein if the substrate is present in the sample, formed are complexes comprising the functionalized, encapsulated fluorescent nanocrystals bound to the substrate;

(b) exposing the complexes, if formed, in the detection system to an excitation light source suitable for exciting the functionalized encapsulated fluorescent nanocrystals to emit a fluorescence peak; and

(c) detecting the fluorescence peak emitted by the complexes, if present, by a detection means for detecting the fluorescence peak;

wherein the detection of a fluorescence peak is indicative of the presence of the substrate.

25. The method according to claim 24, wherein the presence of the substrate is detected, and further comprises quantitating the amount of substrate present by measuring the intensity of the fluorescence peak emitted.

26. The method according to claim 24, wherein the affinity molecule comprises a nucleic acid molecule, and wherein the detection system comprises hybridization.

27. The method according to claim 24, wherein the detection system is selected from the group consisting of a fluorescence-based immunoassay, fluorescence-based detection systems, microarrays, fluorescent staining, flow cytometry, strand synthesis, molecular sorting, molecular tracking, and fluorescence imaging.

28. The method according to claim 24, wherein the affinity molecule comprises a monoclonal antibody.

29. The method according to claim 24, wherein the surface groups comprising a nucleobase, and wherein the detection system comprises strand synthesis in which functionalized encapsulated fluorescent nanocrystals are incorporated into a nucleic acid strand synthesized in a template-directed manner.

30. The method according to claim 24, wherein fluorescence is detected, the method further comprising contacting the functionalized, encapsulated fluorescent nanocrystals in the detection system with a lipolytic agent in an effective amount to disrupt liposome portions of the functionalized, encapsulated fluorescent nanocrystals in releasing fluorescent nanocrystals; and removing the released fluorescent nanocrystals from the detection system so as to quench the fluorescence.

31. A method of making functionalized encapsulated fluorescent nanocrystals, the method comprising:
(a) mixing fluorescent nanocrystals with a lipid mixture to form a dried lipid mixture film;
(b) contacting the dried lipid mixture film with an aqueous solution; and
(c) mixing the dried lipid mixture film with the aqueous solution in forming functionalized, encapsulated fluorescent nanocrystals.

32. The method according to claim 31, wherein the fluorescent nanocrystals and lipid mixture are mixed in an organic solvent, and the organic solvent is evaporated to form the dried lipid mixture.

33. The method according to claim 31, wherein an organic solvent containing fluorescent nanocrystals is evaporated in forming a dried preparation of fluorescent nanocrystals, and an organic solvent containing the lipid mixture is evaporated in forming a dried preparation of lipid mixture; and the dried preparation of fluorescent nanocrystals and

the dried preparation of lipid mixture are mixed to form the dried lipid mixture.

34. The method according to claim 31, wherein the fluorescent nanocrystals comprise semiconductor nanocrystals.

35. The method according to claim 31, wherein the fluorescent nanocrystals comprise doped metal oxide nanocrystals.

36. The method according to claim 31, wherein the fluorescent nanocrystals comprise semiconductor nanocrystals and doped metal oxide nanocrystals.

37. The method according to claim 31, wherein the dried lipid mixture film further comprises a component for substitution selected from the group consisting of a membrane stabilizer, an isotonic agent, a pH adjusting agent, an aggregation minimizer, an affinity molecule, an amino acid, and a combination thereof.

38. The method according to claim 31, wherein the aqueous solution further comprises a component for substitution selected from the group consisting of a membrane stabilizer, an isotonic agent, a pH adjusting agent, an aggregation minimizer, an affinity molecule, an amino acid, and a combination thereof.